III REMARKS

The specification has been amended to clarify the definition of "synchronous generator" as used in the specification. The definition is taken from the Electrical Generating Systems Association (ESGA) document "ESGA 101G 1998 Glossary Of Electrical And Mechanical Terminology And Definitions". No new matter is introduced because the definition conforms to what is well known in the art.

Applicant's Response to Each paragraph of the Final Rejection

For clarity, the paragraph numbers used below correspond to like numbered paragraph items in the Final Rejection.

Items 1-2. Examiner states that the features upon which applicant relies (i.e., exciter field) are not recited in the rejected claim(s). Applicant's invention employs permanent magnet synchronous generators (no exciter field is available) or wound field synchronous generators (exciter field has constant DC current). The claims have been amended to clarify this by adding the following or similar language to the appropriate claims:

> "a synchronous generator selected from a group consisting of wound field synchronous generators wherein an exciter field is excited with a constant current and permanent magnet synchronous generators"

Item 3. Applicant reasons that the references not only do not teach the claimed limitations, but both Fox and Richardson teach away from applicant's invention. Fox teaches using a voltage regulator to modify the exciter field current of a generator. Richardson teaches controlling field orientation to regulate either stator currents or voltages to control the torque reacted by an induction generator. As stated in Item 2, above, applicant's invention employs permanent magnet synchronous generators (no

exciter field is available) or wound field synchronous generators (exciter field has constant DC current).

Item 4. Examiner has stated "one cannot show non-obviousness by attacking references individually where the rejections are based on combinations of references." Applicant is unable to find a way that the references can be combined without rendering the references unsatisfactory for their intended purpose.

If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.

Applicant recognizes it is not necessary that the inventions of the references be physically combinable to render the invention obvious. However, a proposed modification cannot change the principle of operation of the primary reference or render the reference inoperable for its intended purpose. Substituting applicant's claimed permanent magnet or constant DC exciter field generators for the variable field generators of <u>Fox</u> and <u>Richardson</u> in Examiner's proposed combination would change the principle of operation of the primary reference (wherein either <u>Fox</u> or <u>Richardson</u> is considered the "primary reference") and render the reference inoperable for its intended purpose.

Item 5. To support a finding that there is a teaching, suggestion, or motivation to combine the references, Examiner has stated that in this case, "all applied prior art references share a general set of elements in a particular configuration which allows them to effectively and efficiently generate electricity." Applicant submits that the assertion that the references "share a general set of elements in a particular configuration" is not a teaching

(imparting knowledge), not a suggestion (a proposal put forward for consideration) nor a motivation (reason for combining the references).

If all three applied references are combined, the result is still an apparatus for generating electricity that must rely on field control of generators. For example in Richardson the generator controller uses field orientation to regulate either stator currents or voltages to control the torque reacted by the induction generator. In Fox exciter field current for the generator is provided such that the voltage output of the generator is proportional to the exciter field current. Applicant teaches that torque is controlled by regulating DC current at an inverter.

Items 6-7. Claims 1, 8-15, 21-23, and 28 were rejected under 35 U.S.C.102(b) as being anticipated by U.S. Patent No. 5,017,857 to Fox.

In Fox exciter field current for a generator is provided such that the voltage output of the generator is proportional to the exciter field current.

Applicant's invention employs permanent magnet synchronous generators (no exciter field is available) or wound field synchronous generators (exciter field has constant DC current). The claims have been amended to clarify this by adding the following or similar language to the appropriate claims:

> "a synchronous generator selected from a group consisting of wound field synchronous generators wherein an exciter field is excited with a constant current and permanent magnet synchronous generators"

Item 8. Examiner states that with regards to claim 28 Fox discloses applicant's method of generating electric power.

Voltage regulator 36 of Fox monitors the output voltage of the inverter, the current signals of the inverter and the output 90 of signal conditioning circuit 59. "All of these inputs are used by the voltage regulator to control the exciter field current of the generator 10 by way of line 60." (Column 2, lines 62-65).

Applicant's control unit 122 is connected to the sensors at TCU 132 and to the active inverter 136 (figure 3). Applicant's control unit 122 causes the inverter to regulate the DC current of the inverter in accordance with the sensor information from sensor inputs (figure 5) not an exciter field as required by Fox. See applicant's specification page 8, lines 12-22, reproduced below:

> The inverter regulates the DC current and by doing so, the generator torque is controlled. The inverter regulates this DC current by synchronizing to the grid and by supplying unity power factor current into the grid system. The control of the inverters is provided by a generator control unit (GCU) 122. The GCU, 122 takes inputs such as grid voltage, DC bus voltage, grid current, and commands such as torque level from a Turbine Control unit (TCU) 132. These commands are converted into pulse-width-modulated (PWM) signals which tell switching devices (such as Insulated-Gate-Bipolar- Transistors, IGBTs, Metal-Oxide-Semicomductor-Field-Effect-Transsitors, MOSFETs, , Gate-Turn-Off devices, GTOs, or Silicon-Controled-Rectifiers or SCRs' etc) in the inverter when to turn on and off. These switches are controlled in such a way as to maintain regulated DC current.

In Fox inputs are used by the voltage regulator to control the exciter field current of the generator 10. Fox does not vary DC electrical current at the inverter in accordance with variations in said sensor information as called for by applicant's claims.

Items 9-10. Claims 2-7, 16-18, 24-25 and 29-31 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,017,857 to Fox in view of U.S. Patent No. 5,083,039 A to Richardson et al.

Examiner states that:

> It would have been obvious to one skilled in the art at the time the invention was made to use the circuit and method for voltage regulation of electric power sources disclosed by Fox on the variable speed wind turbine disclosed by Richardson et al. for the purpose of building a high capacity wind turbine while using readily available generators.

The variable speed wind turbine disclosed in Richardson comprises a turbine rotor that drives a pair of AC induction generators with two respective power converters. The converters contain an active rectifier that controls generator torque by means of a field-orientation method. The converter contains an inverter, which is synchronized to the AC line and controls the DC bus voltage by maintaining a power balance between the generator and the AC grid. The inverter shifts the current waveform relative to the grid voltage. Variable reactive power, or power factor is controlled in this way. Because Richardson uses an induction generator, an active rectifier is used as the magnetizing component of the generator, which is excited by the DC bus through control of the active rectifier.

Richardson uses an induction generator and teaches controlling field orientation to regulate either stator currents or voltages to control the torque reacted by the induction generator. As stated in Item 2, above, applicant's invention employs permanent magnet synchronous generators (no exciter field is available) or wound field synchronous generators (exciter field has constant DC current).

<u>Fox</u> uses a generator having an exciter field, the current of which is varied by a voltage regulator. Voltage regulator 36 of <u>Fox</u> monitors the output voltage of the inverter, the current signals of the inverter and the output 90 of signal conditioning circuit 59. "All of these inputs are used by the voltage regulator to control the exciter field current of the generator 10 by way of line 60." (Column 2, lines 62-65).

Applicant's control unit 122 is connected to the sensors at TCU 132 and to the active inverter 136 (figure 3). Applicant's control unit 122 causes the inverter to regulate the DC current of the inverter in accordance with the sensor information from sensor inputs (figure 5) not an exciter field as required by <u>Fox</u>.

Item 11. Examiner states that with regards to claims 4 and 18, it should be emphasized that "apparatus claims must be structurally distinguishable from the prior art."

Claim 4 is a dependent claim and contains all limitations of the claims from which it depends. The arguments presented above in respect of claim 1 apply to claim 4.

Claim 18 is a dependent claim and contains all limitations of the claims from which it depends. The arguments presented above in respect of claim 16 apply to claim 18.

Item 12. Examiner states that with regards to claim 5, it would have been an obvious matter of design choice to use a set of power cables to conduct DC electrical power from the top of said tower to the bottom of said tower, since the applicant has not disclosed that longer power cables solve any stated problem or is for any particular purpose and it appears that the invention would perform equally well with short power cables.

Claim 5 states:

The electric power-generating device of claim 1 wherein electric power-generating device is a wind turbine that includes said generator and said rectifier, said wind turbine being located at the top of a tower and wherein said inverter is located at the bottom of said tower.

Applicant has disclosed that longer power cables are for the purpose of providing a lower total quantity of cables. Page 10, lines 1-10, of applicant's specification states:

> The preferred approach in the invention is to place the passive rectifier uptower and convert the synchronous generator AC voltage to DC. This results in a higher operating voltage on the pendant cables and lower total quantity of cables as each generator/rectifier now has two conductors associated with it rather than three conductors each. The DC pendant cables are only possible because of the coordinated high impedance of the synchronous generator, which limits the DC fault current in the event of a ground or pendant cable fault. The GCU which senses the DC bus voltage and current sense this fault condition and bring the turbine to zero speed very quickly. While this takes a finite amount of time, the current does not build up as it would with a low impedance case and the shutdown is very controlled and orderly.

It is the use of synchronous generator as defined in claim 1 (upon which claim 5 depends) that makes the use of DC pendant cables possible because of the high impedance of synchronous generators. Claim 5 is also allowable for the same reasons set forth in respect of claim 1.

Item 13. Examiner has stated that with regards to claims 29-31, Fox in view of Richardson et al. disclose applicant's method of generating electric power.

The reasoning set forth in Item 9-10 above applies to claims 29-31.

Item 14. Claims 19-20,26-27, and 32-34 were rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,017,857 to Fox in view of U.S. Patent No. 5,083,039 A to Richardson et al. as applied to claims 2-7 and 16-18 above, and further in view of U.S.Patent No. 6,724,097 Bl to Wobben.

Wobben uses power output, rate of change of power output and power factor at individual wind turbines arranged in a wind farm for the purpose of controlling the total power output of the wind farm to thereby maintain compatibility with a utility to which the wind farm is attached. In contradistinction, applicant claims a dynamically adjustable power factor controller using a device separate from the wind turbines and located at a substation for adjusting the power factor of the aggregate output of a wind farm.

In Figure 1 Wobben shows a power factor control and a dp/dt control function at the wind turbine. Brief mention is made of this in column 3, line 6 through 12. In applicant's application each turbine 710 (Figure 7) operates at a fixed power factor and power factor is not controlled at the turbines as Wobben has discussed.

Wobben discloses controlling power level, not power factor, or dp/dt and applicant controls power factor by means of a separate dynamic VAR control device 740 (Figure 7) that is separate from the uncontrolled unity power factor wind turbines and is located in the substation 730. Fox in view of Richardson et al. fails to disclose a fluid flow farm.

Wobben is cited by Examiner to teach the construction of a method for operating a wind farm comprising a plurality of fluid-flow turbines each of which converts fluid-flow power into AC electrical power at unity power factor. However, Wobben does not

teach fixed power factor but instead varies the power factor by the data processing apparatus of Figure 1 and uses the wind turbine to cause the varying power factor at the wind plant.

The Wobben data processing apparatus does not electrically connect each of the turbines to a substation wherein a dynamically adjustable power factor controller adjusts the power factor of the aggregate output of the wind farm. The Wobben data processing apparatus adjusts the power output of each turbine individually. This is shown in Figure 1 of Wobben wherein the input P is from a single wind turbine shown to the left of the drawing and is the power output of that one turbine. The implication of Wobben is that the microprocessor uP and inverter arrangement (rectifier, intermediate circuit and inverter) shown in Figure 1 and described at column 3, lines 14-19, is replicated for each of the three wind turbines shown in Figure 2. Each of the turbines 1, 2, 3, has a corresponding power output P1, P2 and P3 that enter the data processing apparatus (i.e. the microprocessors uP) as shown in Figure 2 to control the power output of each turbine. Therefore there is no dynamically adjustable power factor controller in Wobben that adjusts the power factor of the aggregate output of the wind farm.

Wobben at Column 3, lines 28-34 states:

> As each of the individual wind power installations has a power input for setting the power output of the respective installation (FIG. 1), the power output levels of an individual wind power installation can be set to a desired value by means of a data processing apparatus, by means of which the entire wind park is controlled.

Thus it is seen that Wobben controls the power output of each wind turbine installation.

Examiner asserts that it would have been obvious to one skilled in the art at the time the invention was made to use the circuit and method for voltage regulation of variable speed wind turbines and electric power sources disclosed by Fox in view of Richardson et al. on the wind farm disclosed by Wobben for the purpose of providing a wind park equipped with a total power output which is higher than the maximum possible network feed-in power output.

The claims were rejected as being unpatentable over Fox in view of Richardson and further in view of Wobben. Fox is the primary reference relied upon, and is the "reference" referred to in Step 1. Fox is the reference to be modified.

The Examiner proposes that it would be obvious to modify the applied reference (Fox) to use the elements of Richardson and Wobben to provide the claimed wind farm. The Examiner has failed to point out why the proposed modification would be obvious.

Applicant's invention is a combination and the crucial suggestion or motivation step in determining obviousness must be considered. Neither Fox nor Richardson nor Wobben contain anything to suggest the desirability of applicant's claimed combination or any motivation to modify Fox to effectuate adjusting the power factor of the aggregate output of the turbines.

The references when combined do not teach or suggest all the claim limitations, because the references do not teach controlling the power factor at a substation separate from the wind turbines. Wobben teaches away from such a modification because Wobben controls the power factor at each wind turbine installation and does not control power factor at a substation to vary the power output of the wind farm.

Item 15. Examiner has sated that with regards to claims 32-34, Fox in view of Richardson

et al. in view of Wobben disclose applicant's method of generating electric power .

The reasoning set forth in item 16 above applies to claims 32-34.

Conclusion

Applicant's attorney requests a telephonic interview or a personal interview with the Examiner prior to a substantive Office Action.

Examination of new claims 35-36, re-examination of claims 1-34, and allowance of claims 1-36 is respectfully requested.

Respectfully submitted,

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